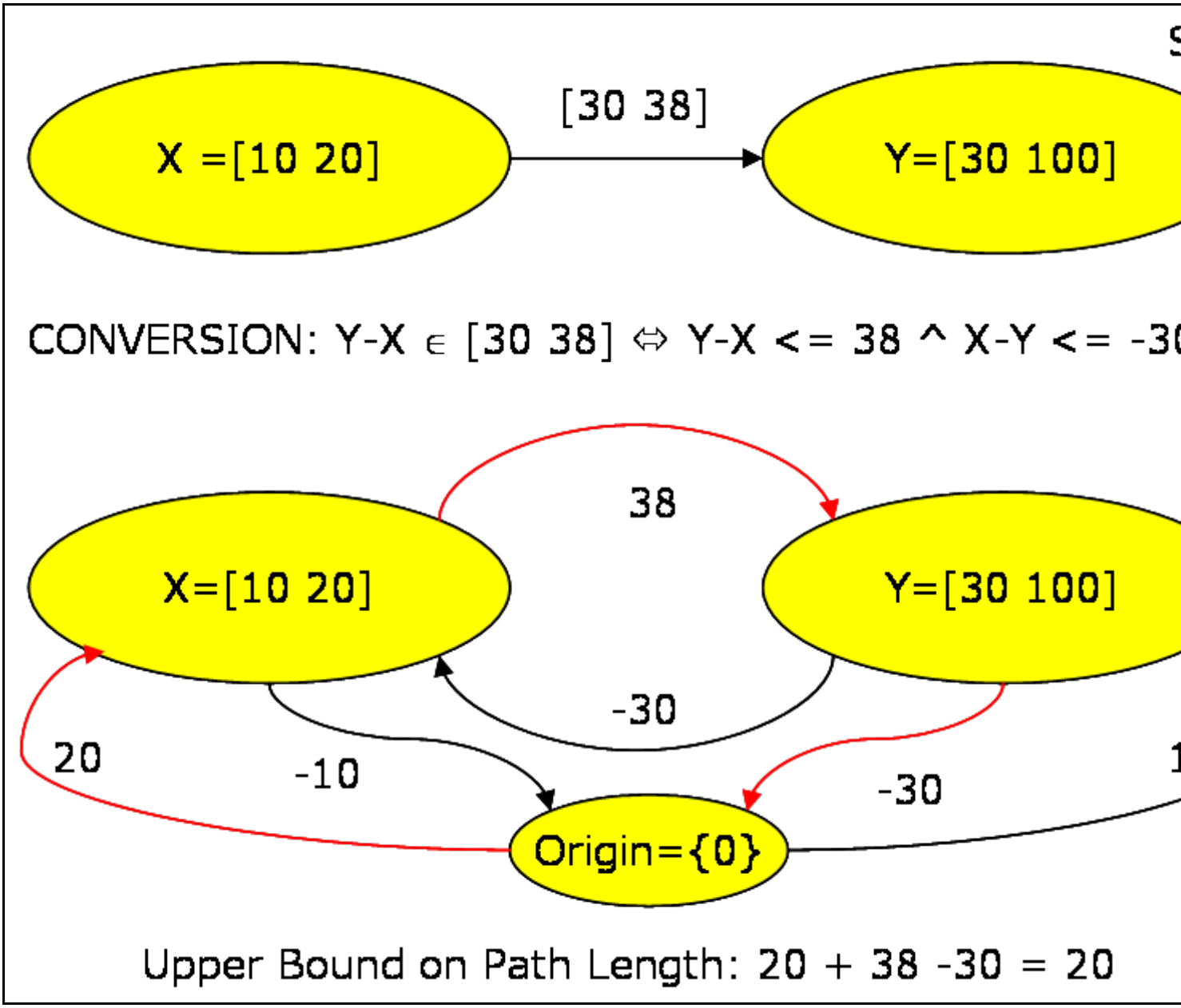
Simple Temporal Problems (Networks)

The notion of time is central to temporal planning. EUROPA uses *variables* to explicitly represent *timepoints* for plan activities and states. *Constraints* among *timepoints* provide a natural way to express domain axioms. For example, in order to state that activity *A* must occur before activity *B* we can say that the end *timepoint* of *A* is <= the start *timepoint* of *B*. Dechter et al. (Dechter 1991) proposed that *constraints* among *timepoints* can be grouped together to form a Simple Temporal Network (*STN*). Such a network can be transformed into a Distance Graph (*DG*) where the outward arc from a node represents the maximum distance from the source node to the target node. The diagram below illustrates a simple *STN* with just 2 variables and a single constraint. It also shows the resulting *DG*.



Dechter et al. (Dechter 1991) also showed that shortest path algorithms could be used to propagate values in the

network and discover a *negative cycle*. A *negative cycle* is a path from a node to itself that has a path length less than 0. If such a cycle exists, the network is inconsistent. It was further shown that a single-source shortest path algorithm was sufficient to detect a negative cycle and provide sufficient propagation to yield a backtrack-free search. Thus we have an efficient and complete algorithm for propagating an *STN*. These results build on the already established notion of a *CSP* and are naturally incorporated into the general representation and propagation scheme used in EUROPA.